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JANUARY 18, 1988

CHEMICAL & ENGINEERING

NEWS

Chemical companies' R&D spending to increase this year
Page 9

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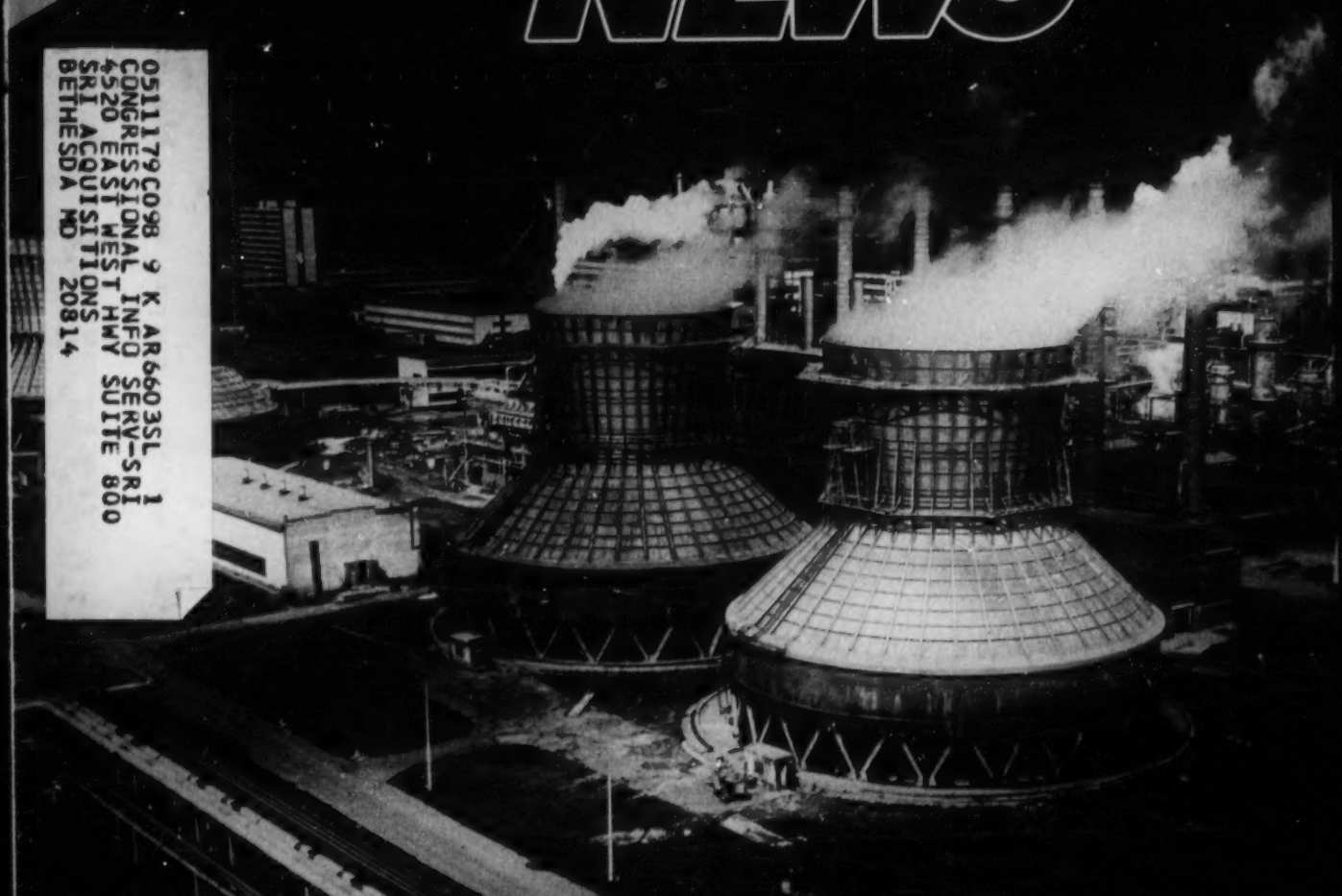

Soviet Chemical Industry

Economic reforms bring gradual change
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CHEMICAL & ENGINEERING
NEWS

Volume 66, Number 3
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JANUARY 18, 1988

News of the Week

■ **Reagan-Takeshita meeting opens negotiations for U.S.-Japanese scientific exchange, but policy differences jam process.** Page 4

■ **Lawsuit by Sterling Drug Co. impelled by Hoffmann-La Roche's hostile takeover attempt emphasizes differences in U.S. and Swiss accounting practices.** Page 5

■ **Du Pont's celebration of nylon and Teflon's 50th anniversary pays tribute to materials revolution, looks to future developments.** Page 5

■ **In acerbic response to U.S. acid rain report, Canada's environment minister calls it flawed, incomplete, and misleading.** Page 6

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Business

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Government

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Science

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High-temperature superconductors are used to make an electrical motor at Argonne National Laboratory. **Page 23**

First examples of simple metal carbonyls of zirconium and titanium are synthesized by University of Minnesota chemists. **Page 23**

Technology

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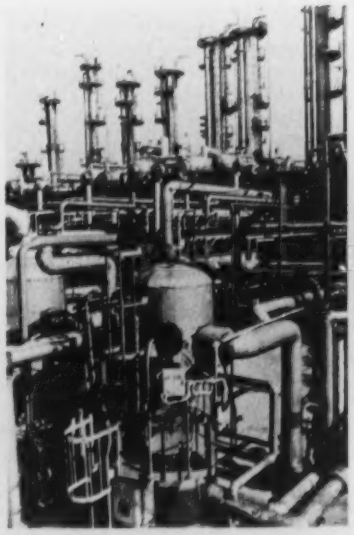

Cover: Nizhnekamsk petrochemical complex, near Kazan, a leading producer of synthetic rubber and commodity petrochemicals; it has recently been involved with a joint venture in instrumentation with Combustion Engineering. Photo by Tass from Sovfoto

Special Report

In U.S.S.R., influx of new Gorbachev-backed ministers to industrial posts bodes well for economic and social reforms in the chemical industry. **Page 28**

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Chemical & Engineering News

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LETTERS

ACS activities

SIR: There is a simple answer to J. J. Doheny's plea (C&EN, Nov. 23, 1987, page 2) for ACS governance to draw a line in determining what activities are suitable for the society to sponsor. (Those he questions include selling jewelry in our exhibit areas, sponsoring concerts, introducing a lonely hearts page in C&EN and others.)

The simple way to determine the suitability of any candidate ACS activity is to test whether it contributes to the survival of the society. That is, to determine whether or not it earns at least as much money as it costs. Soon enough the members will tell us with their pocketbooks how strongly they approve of an activity. And I, for one, prefer the law of the marketplace—every time—to an arbitrary ruling by those who think they represent some silent majority. In short, we don't need to address the three criteria laid down by the Membership Affairs Committee, but only one: "Will it pay?"

B. J. Luberoff
Summit, N.J.

Agent orange exposure

SIR: This is in regard to your article, "Science Failing To Back Up Veteran Concerns About Agent Orange" (C&EN, Nov. 9, 1987, page 7). We believe some aspects of this article deserve comment.

To begin, there seems to be a strong sense in this article that science has done all it can do to investigate the effect of exposure on Vietnam veterans and has reached a stalemate, with very little tangible results. The tenor here seems to be frustration and a strong urge to throw in the towel on this issue. We believe that there remains significant research yet to be done and that the real work is only beginning.

Progress is being made, although it is slow and sometimes very frustrating. You inadvertently point this out in the article when you say that "no one denies" that those who handled agent orange regularly are likely to have elevated levels of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). The fact is that just a few years ago that was precisely the denial in many circles, until science proved that such levels could be found.

We believe there may be better exposure models to test veterans than the "hit" model used by the Centers for Disease Control. We believe it is possible to identify exposed veterans by using a combination of military records and other sources. Our current research, "Pointman II," focuses on an environmental model that will look at a particular group of infantry personnel from the Second Battalion, Eighth Cavalry. We have identified with good precision their activities in the Third Corps area of Vietnam. This unit worked extensively in defoliated areas north of Tay Ninh in 1969. At this point we do not know what levels of TCDD we may find in these veterans, but it is vitally important to continue to investigate specifically identified groups in order to potentially identify those who may have been heavily exposed.

Perhaps certain elements of the federal government want to walk away from Vietnam veterans, but we feel it is immoral to do so. New and creative approaches to this research are needed, and we support such concepts as federally funded investigator-initiated projects. This would allow those with a desire to pursue this research to do so, probably at far lower overall cost than CDC-type efforts.

We don't know what effect agent orange may have on Vietnam veterans, but until we've exhausted all reasonable investigations, we have not tried hard enough to find the answer.

William W. Lewis
Project Coordinator
New Jersey Agent Orange Commission
Trenton, N.J.

Hazardous waste

SIR: This is in regards to the article on hazardous waste in household garbage (C&EN, Oct. 12, 1987, page 14). Although the study is interesting, some of the substances comprising those so-called hazardous products are ending up highly diluted. What is important is to watch that nothing other than household garbage is disposed of in any unregulated dumpsite.

To call alcohol, acetone, and a diversity of esters "hazardous" is improper, because they are produced in much larger quantities by natural fermentation processes of the same garbage components.

If household maintenance residues are the largest source of hazardous products, then we may have to live with them. It would be impractical if all households would be required to set up several cans for each of the individual types of waste. Then where would they go?

However, if the concern is waste in general because we are running out of space, then there are the studies of Elec-

Chemical Industry R&D Spending To Rise Modestly in 1988

Major chemical producers plan 6% hike in research expenditures this year, translating to only about 1.5% in constant-dollar terms

Marc S. Reisch, C&EN New York

The U.S. chemical industry projects only a modest increase in its research and development spending in 1988, according to C&EN's annual survey of large chemical producers.

The survey indicates that R&D spending for 11 companies will increase 6% this year, following a similar increase in 1987. (Du Pont, which is usually included in the C&EN survey, declined to estimate 1987 spending or to forecast 1988 expenditures.) The 6% increase in planned R&D expenditures determined by C&EN's survey is only marginally lower than the 6.9% increase in R&D spending for all industry forecast by Battelle Columbus Laboratories for 1988.

But the chemical industry's 6% increase means that, adjusted for inflation, chemical R&D spending will be up only 1.5% in 1988. This constant-dollar increase is figured using Battelle's estimate for 1988 R&D inflation of about 4.5%.

If Du Pont's 1988 R&D spending increase turns out to be modest, constant-dollar spending could show a marginal decrease. Du Pont traditionally spends more on R&D than any of the other 11 companies included in this survey. In 1986, for instance, Du Pont spent $1.07 billion, or almost 32% of the total R&D expenditures of the group.

The modest increase in constant-dollar R&D spending can be attributed in part to the mergers, acquisitions, and company restructurings that have taken place within the industry over the past few years. Myron Foveaux, trade and economic policy adviser to the Chemical Manufacturers Association, notes that many R&D facilities have been merged during the past five years and that fewer people are now engaged in research activities as a result. He expresses concern that recent increases in R&D spending are falling below the average annual rate of increase of 12.7% for the decade 1977 to 1987. "Spending for R&D for new products traditionally has been the engine of growth for the chemical industry," he notes.

R&D spending as a percentage of sales has decreased marginally in 1987 to 5.0%, compared with 5.4% the year before. Part of the reason may be that sales growth has been better for the chemical industry in 1987 than had been anticipated when 1987 R&D spending plans were put into place. Based on spending plans of the 11 companies in the survey, 1988 R&D spending as a percentage of sales will probably remain about the same as in 1987.

The biggest increase in R&D spending for 1988 is planned by Air Products & Chemicals, whose spending is slated to rise 17.5% to $67 million as the company targets research to increase the purity of gases for the electronics industry. Other increases in the company's R&D are planned for urethane additives and noncryogenic gas separations. Air Products' planned increase for 1988 follows a 6.6% decline in R&D spending last year—a decline greater than the 3.3% decrease originally planned for 1987.

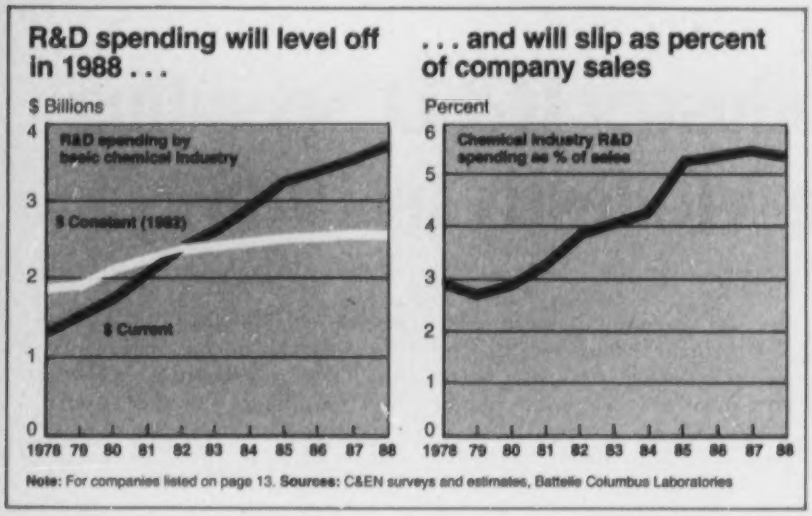
The second largest R&D increase in 1988 is planned by American Cyanamid, which expects to increase R&D funding 13% to $356 million in 1988. That increase follows a similar rise the year before, when Cyanamid says it spent the $315 million it originally planned to spend.

Union Carbide also plans an above-average increase in R&D spending for 1988: 9.4% to $175 million. That increase follows an 8.1% increase the year before. R&D spending as a percentage of sales has remained constant at 2.4% in both 1986 and 1987 for Carbide.

W. R. Grace plans to spend $120 million on R&D in 1988, up 9.1% from the previous year. The increase in its R&D effort is decelerating compared with what the company says it spent in 1987. In 1987 Grace spent $110 million on R&D, up 17% from the $94 million spent in 1986.

Rohm & Haas predicts a more modest 7.1% increase in its R&D

Air Products scientist studies gas purification at lab in Allentown, Pa.



Note: For companies listed on page 13. Sources: C&EN surveys and estimates, Battelle Columbus Laboratories

budget, increasing to $150 million. That increase is better than the 5.3% increase in 1987 to $140 million.

Dow Chemical plans to increase spending dramatically less in 1988, with R&D spending rising only 6.7% to $720 million, compared with an 11.6% increase in 1987 to $675 million. The company's R&D spending as a percentage of sales, at 5.8% in 1987, is the fourth highest in the survey after American Cyanamid, Monsanto, and Rohm & Haas.

Hercules plans to increase its R&D effort in 1988 some 5.6%, an improvement over its 1.4% increase in 1987. However, it did transfer its water-soluble polymers business to a joint venture with Henkel in 1987, and thus the R&D figures for that business are not included in the 1987 numbers. For 1988, Hercules comes in a tad under the average increase in R&D budget growth determined in this survey.

Six companies mentioned so far are planning R&D budget increases above the average for the 11 that responded to the survey, and one, Hercules, is just under the average. An additional company is planning an increase of about 1% and three others are planning no increase at all. Given the 4.5% increase necessary just to stay even in constant-dollar spending, four companies actually plan a decline in constant-dollar spending: Monsanto, PPG Industries, Olin, and Ethyl.

Monsanto plans a very modest 0.9% increase in 1988 to $538 mil-

In a merger of strengths
Some Things Change. . . .
Hoechst Celanese Chemical Group
Hoechst Celanese
Hoechst

R&D spending as percent of future-oriented expenditures stabilized in 1987

R&D expenditures as a percentage of future-oriented spending (capital expenditures plus R&D expenditures) has been fairly stable over the past two years for the 12 major chemical producers C&EN contacted for its annual survey. In 1987 the R&D portion accounted for 38.3% of a total $9.32 billion in future-oriented spending, and in 1986 it accounted for 38.4% of a total $8.76 billion.

The relationship has been preserved because R&D spending and capital spending for the 12 companies grew at about the same 6% rate in 1987. In its recent survey of chemical capital spending, C&EN reported that capital spending by the same 12 major chemical companies rose 6% in 1987 to $5.75 billion (C&EN, Dec. 21, 1987, page 10).

The relationship between the two spending figures has changed dramatically since 1980, a year when capital expenditures for the 12 companies were at $6.66 billion, or 78.8% of a total $8.45 billion in future-oriented spending, and R&D expenditures were 21.2%.

However, by 1983 the relationship had changed drastically. R&D spending amounted to 34.8% of the total $7.50 billion directed at future-oriented spending. The R&D figure rose steadily to 36.5% of future-oriented spending in 1985 and hit its highest point in 1986, when 38.4%, or $3.36 billion, went to R&D efforts for the 12 companies in the survey.

lion. That's a far cry from last year, when the company's R&D budget fell 10.6% to $533 million. Although Monsanto added the expanded research programs of its Searle subsidiary to its budget in 1986, it has subsequently trimmed its R&D levels, bringing R&D spending as a percentage of sales down from 8.7% in 1986 to 7.4% in 1987. Monsanto, however, generally spends more on R&D as a percentage of sales than any other company in the survey, the industry averages for which were 5.4% in 1986 and 5.0% in 1987.

Among diversified manufacturers, which C&EN has included in its survey for the first time this year, four companies plan to increase their R&D budgets 4% in 1988. They are Allied-Signal, Eli Lilly, FMC, and Morton Thiokol. Their figures include internally generated R&D only and not government contracts. Morton Thiokol's 1988 planned government-sponsored R&D at $250 million, for instance, dwarfs the

And Some Things Don't.

On January 1, 1988, Celanese Chemical Company, Inc. becomes Hoechst Celanese Chemical Group.

CIRCLE 12 ON READER SERVICE CARD

Air Products, American Cyanamid will post biggest gains in R&D spending

$ Millions	Planned 1988	Actual 1987	Planned 1987	1986	1985	1984	1983	1982	Change from previous year 1988	Change from previous year 1987	R&D spending as % of sales 1987	R&D spending as % of sales 1986
CHEMICAL COMPANIES												
Air Products[a]	$ 67	$ 57	$ 59	$ 61	$ 51	$ 44	$ 40	$ 37	17.5%	−6.6%	2.7%	3.1%
American Cyanamid	356	315	315	278	251	232	208	185	13.0	13.3	7.9	7.3
Dow Chemical	720	675	650	605	547	507	492	460	6.7	11.6	5.8	5.4
Du Pont[b]	na	na	1110	1070	1080	1000	875	775	na	na	na	6.8
Ethyl	52	52	47	47	47	40	39	39	0	10.6	3.1	2.9
W. R. Grace	120	110	110	94	92	81	73	64	9.1	17.0	2.8	2.5
Hercules	76	72	68	71	76	72	74	74	5.6	1.4	2.6	2.7
Monsanto	538	533	575	596	470	370	290	264	0.9	−10.6	7.4	8.7
Olin	60	60	60	56	53	52	49	45	0	7.1	3.3	3.3
PPG Industries	250	250	na	204	176	150	127	127	0	22.5	5.1	4.4
Rohm & Haas	150	140	133	133	124	109	100	92	7.1	5.3	6.5	6.4
Union Carbide	175	160	na	148	275	265	245	240	9.4	8.1	2.4	2.4
TOTAL	$2564	$2424	$3127	$3363	$3242	$2922	$2612	$2402			5.0%	5.4%
ANNUAL CHANGE[c]	6%	6%		4%	11%	12%	9%	15%				
DIVERSIFIED COMPANIES												
Allied-Signal[d]	670	670		462	343	258	245	166	0	45.0	5.4	3.9
Arco Chemical	na	na		30	29	29	na		na	na	na	1.9
Eli Lilly	500	450		427	370	341	294	267	11.1	5.4	11.5	11.5
FMC	134	134		146	149	121	102	105	0	−8.2	4.2	4.9
Merck & Co.	na	530		480	426	393	356	320	na	10.4	12.2	11.6
Morton Thiokol[d,e]	43	40		38	34	28	21	7	7.5	5.3	2.0	1.9
SmithKline Beckman	na	425		377	310	279	265	222	na	12.7	11.3	11.6
TOTAL	$1347	$2249		$1960	$1661	$1449	$1263	$1087			7.2%	6.7%
ANNUAL CHANGE[c]	4%	17%		18%	15%	11%	18%	14%				

a For fiscal year ended Sept. 30. b All figures exclude Conoco. c For those companies reporting. d Includes all company-financed R&D, but excludes contract R&D. e Fiscal year ended June 30. na = not available.

money the company spends on its chemical and salt operations. Allied-Signal's government and other contract R&D spending, at $530 million, is almost as large as the $670 million Allied spends on internal R&D.

Among the pharmaceutical manufacturers included for the first time, only Eli Lilly could provide an estimate of what it planned to spend in 1988. Its $500 million in R&D expenditures planned in 1988 is 11.1% higher than in 1987, and its 1987 R&D expenditures were 5.4% ahead of 1986. Merck and SmithKline Beckman reported that they had spent $530 million and $425 million, respectively, in 1987, marking 10.4% and 12.7% increases in R&D spending over 1986.

The Pharmaceutical Manufacturers Association (PMA), an organization representing more than 100 research-based pharmaceutical companies in the U.S., recently reported a survey indicating that the industry increased its R&D spending 14.9% in 1987 and 14.6% in 1986. Eli Lilly, Merck, and SmithKline fall below the industry level of increase, according to C&EN's survey.

PMA also estimates the industry level of R&D spending as a percentage of sales at 15.1% in 1987 and 14.8% in 1986. Again, the companies surveyed by C&EN came in under the industry level. Eli Lilly spent 11.5% of its sales on R&D in both 1986 and 1987, and Merck spent 11.6% and 12.2% in 1986 and 1987, respectively. SmithKline spent 11.3% of sales on R&D in 1987 and 11.6% in 1986.

As a group, however, the three pharmaceutical companies consistently spent more on R&D than other diversified companies surveyed and are in large measure responsible for the year-to-year increases shown in the group.

Although Allied-Signal's $670 million spending plans show no growth in its R&D budget for 1988, the company did show a rather hefty increase of 45% the year before, when R&D spending as a percentage of sales increased dramatically to 5.4% from 3.9% in 1986.

Arco Chemical, spun off from Atlantic Richfield late last year, is included in the diversified table as well. Historical data from its prospectus show a rather consistent level of R&D by this manufacturer of commodity chemicals (such as propylene oxide, styrene, and oxygenated fuels).

FMC reported no plans to increase its R&D expenditures above its 1987 level of $134 million. Its 1987 spending was 8.2% less than in 1986. As a percentage of sales, R&D spending stood at 4.2% in 1987 and 4.9% in 1986.

Morton Thiokol plans a modest 7.5% increase in internally generated R&D this year to $43 million, following a 5.3% increase in 1987. Its R&D spending as a percentage of sales remained fairly constant at 2.0% in 1987 and 1.9% in 1986. □

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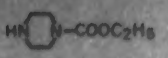
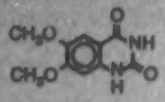
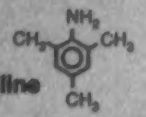


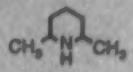
1-Ethoxycarbonylpiperazine



6,7-Dimethoxy-quinazoline-2,4-dione



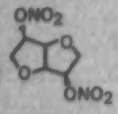
2,4,6-Trimethylaniline
Mesidine



2,6-Dimethylpiperidine, cis

1,3-Cyclohexanedione

Isosorbide dinitrate (ISDN)
mixtures with lactose etc., USP XXI



4-Aminoacetophenone

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CIRCLE 22 ON READER SERVICE CARD

petrochemical products are taxable and some are not when delivered to the same customer in the same tank.

A number of comments focused on administration of the tax. Under the proposal, any transfer or sale of taxable products is taxed. Thus, a chemical producer would have to pay the tax on a shipment of toluene, for example, whether or not it ever ended up in gasoline. However, if the material is not used as a motor fuel, a refund can be applied for. It is even unclear whether or not the tax applies to transfers inside a company facility.

If the exemptions are not allowed (and some say even if they are), a heavy paperwork burden is likely to result. A representative of chemical distributors estimated that at least 30,000 chemical distributors would have to pay the taxes and then file for a refund each quarter. In its comments, Hoechst-Celanese Corp. told IRS these "provisions for the gasoline excise tax will be market damaging and extremely expensive to the entire petrochemical industry."

IRS did provide exemptions for transfers and shipments in bulk. But it defines bulk transfers as quantities of more than 10,000 barrels. Such a quantity could be moved without an upfront payment of the excise tax. Unfortunately, very few shipments are this large. Even when moved on barges or in pipelines, individual loads are smaller than that size limit. There are some safety restrictions that keep shipments below 10,000 bbl even if the barge can hold more. Several industry sources pointed out that in the petrochemicals business, it's not the size of the load that is termed bulk, but the mode of transfer, such as by pipeline. Chemical industry speakers recommended the limit for bulk shipments be put at 15,000 gal, about the size of a railroad tank car.

The bonding requirement was seen as severe by many commenters, and as potentially disastrous for many smaller shippers. Most speakers told IRS that a company that is in good financial condition and has paid its taxes promptly in the past should be exempted from the bonding requirement. It was pointed out that tax cheaters in the past had not held proper tax registration credentials and that refiners should not be punished unnecessarily. One speaker noted that the law gives IRS some discretion in requiring bonding and that the bond requirement was not intended by Congress for faithful taxpayers. How IRS will resolve this is unclear.

No one was objecting to paying the excise tax but many held that this method of collection would not lead to a great increase in revenue. It will generate a tremendous clutter of payments and refund requests that will be burdensome not only to the companies involved, but to IRS as well.

David Hanson, Washington

Federal R&D funding up marginally in 1988

Federal R&D support totals more than $55 billion and accounts for about 9% of discretionary spending in the fiscal 1988 budget, according to the continuing appropriations bill, H.J. Res. 395, approved by Congress late last year. That total represents a 4% increase over fiscal 1987 funding levels, barely enough to keep up with inflation.

H.J. Res. 395 is a massive document, printed on more than 2300 pages. It not only sets budget dollar amounts, but in many cases directs where and how the money is to be spent and on what. Examples can be found in just about every R&D budget, from the largest to the smallest.

The largest, of course, belongs to the Department of Defense, but DOD receives one of the smallest percentage increases in fiscal 1988. Its research, development, test, and evaluation (RDT&E) programs budget rises 2% to $37 billion. However, DOD's technology base budget, which funds basic research programs, is essentially unchanged at $3.2 billion. Within that budget category, funding for DOD's University Research Initiative (URI) is also unchanged at $110 million, with $85 million earmarked for research and $25 million for instrumentation grants. The conferees decided that

"not more than 14% of funds made available in this act for the URI program may be obligated or expended within any one state." That marks the first time Congress has imposed a geographic cap on research funds. Congress also earmarked $135 million of the RDT&E budget for various semiconductor research programs and allotted $15 million for research on high-temperature superconductivity.

Funding for the National Institutes of Health is up 11%, or $733 million, over fiscal 1987, to $6.7 billion. Much of that increase is earmarked for acquired immune deficiency syndrome (AIDS) research by various institutes, which is up 77%, or $196 million, to $448 million. That leaves a 5% increase for NIH's non-AIDS research. House and Senate conferees on H.J. Res. 395 agreed that NIH should fund "approximately 6100 new and competing research project grants, including those related to AIDS."

For the Department of Energy,

Funding for major R&D agencies is up less than $2 billion

$ millions	1988 Final appropriation	1988 Administration request	1987	% change 1987–88
DEFENSE	**$36,814.9**	**$43,436.3**	**$36,121.1**	**2%**
Tactical programs	12,230.6	13,726.5	11,038.6	11
Strategic programs	7,406.3	9,989.9	8,124.7	−9
Advanced technology development	5,357.2	7,163.2	4,930.2	9
Intelligence and communication	4,873.1	5,262.1	4,882.5	0
Defensewide mission support	3,655.5	3,874.0	3,911.9	−7
Technology base	3,247.5	3,420.6	3,233.2	0
Conventional defense initiative	83.2			
Reduction	−36.5			
NIH	**6,666.6**	**5,190.5**	**5,933.5**	**11**
Cancer	1,469.3	1,217.9	1,341.8	10
Heart, Lung & Blood	965.5	801.1	913.3	6
Allergy & Infectious Diseases	638.8	349.4	400.0	60
General Medical Sciences	632.7	482.0	571.2	11
Diabetes, Digestive & Kidney Diseases	534.7	440.5	511.4	5
Neurological & Communicative Disorders & Stroke	534.7	420.3	488.1	9
Child Health & Human Development	396.8	312.6	362.8	9
Research Resources	368.2	254.7	315.1	17
Eye	224.9	184.6	216.5	4
Environmental Health Science	215.7	196.9	209.2	3
Aging	194.7	155.8	177.5	10
Arthritis & Musculoskeletal & Skin Diseases	147.7	123.0	138.8	11
Dental Research	126.3	105.3	115.3	9
Other	216.6	146.4	172.5	26

Note: All figures are estimates. Source: Congressional budget documents

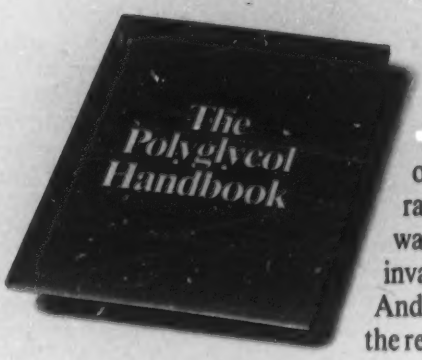
Everything.

*Trademark of The Dow Chemical Company

$ Millions	1988 Final appropriation	1988 Administration request	1987	% change 1987–88
ENERGY	**$4,863.1**	**$4,446.7**	**$4,570.3**	**6%**
Energy supply R&D	2,108.4	1,925.8	2,024.0	4
Supporting research & technical analysis	649.5	561.0	607.4	7
Nuclear	603.8	590.7	610.8	−1
Fusion	335.0	345.6	345.3	−3
Biological & environmental	285.2	217.5	194.0	37
Other	255.9	211.0	266.5	−4
Weapons R&D, testing	1,486.9	1,476.4	1,377.2	7
General science & research	804.5	814.5	719.5	12
Fossil R&D	327.9	149.9	295.9	10
Conservation R&D	156.3	80.1	161.7	−3
NASA R&D	**3,274.2**	**3,651.2**	**3,127.7**	**5**
NSF	**1,717.0**	**1,892.5**	**1,622.2**	**6**
Research & related activities	1,453.0	1,634.5	1,406.2	3
Science education	139.2	115.0	99.0	41
Antarctic program	124.8	143.0	117.0	7
COMMERCE	**1,254.8**	**1,151.9**	**1,168.0**	**7**
NOAA	1,110.0	1,013.3	1,044.6	6
NBS	144.8	138.6	123.4	17
USDA	**979.9**	**897.6**	**953.0**	**3**
Agricultural Research Service	540.7	535.1	514.2	5
Cooperative State Research Service	303.7	240.3	304.1	0
Forest research	135.5	122.2	132.7	2
EPA R&D	**186.4**	**187.6**	**202.5**	**−8**
TOTAL	**$55,756.9**	**$60,854.3**	**$63,706.3**	**4%**

whose overall R&D budget rises 6% to $4.8 billion, funding for chemical sciences is up 13%, or $15 million, to $131 million. Included in the increase is $6.5 million for refurbishing the high-flux isotope reactor at Oak Ridge, Tenn., and "$3.5 million to fund a new initiative in fundamental chemistry as identified by the NAS/NRC Committee to Survey the Chemical Sciences," the group responsible for "Opportunities in Chemistry" (the Pimentel Report). The materials science budget increases 11%, or $17 million, to $172 million. It provides $10 million to initiate a technology program in x-ray lithography, $4 million for creation of a national research program in ceramic superconducting technology, and up to $3.5 million for development of expanded projects and programs in materials processing. And the conferees agreed to provide $25 million out of the $804 million general science and research budget for Superconducting Super Collider

From head to tow.



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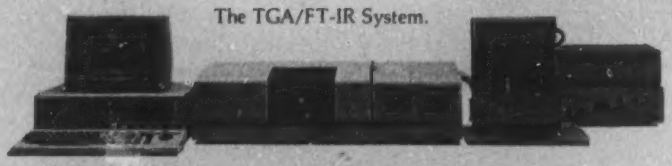

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CIRCLE 33 ON READER SERVICE CARD

R&D. No funds were provided for initiating construction.

On paper the National Aeronautics & Space Administration's budget is up 5%, or $146 million, to $3.3 billion. However, the conferees agreed to Senate language allowing $100 million of 1987 funding for a replacement shuttle to be transferred to the 1988 R&D account, for an 8% increase. Requested funding for the space station was cut $343 million, to $425 million. The conferees noted that it is imperative that NASA examine all possible approaches to constraining station costs so that it can maintain activities such as science research at not less than 20% of its total resources.

The National Science Foundation, which up until the last minute had reason to hope that it would get a good part of the 16% increase requested for its research and related activities budget, instead gets only a 3% increase to $1.5 billion. The Department of Commerce's National Oceanic & Atmospheric Administration's operations, research, and facilities budget increases 6% to $1.1 billion, but the National Bureau of Standards budget rises 17% to $145 million. The NBS budget includes $2.8 million for superconductivity, $1.5 million for composites, and $950,000 for cleanup of polychlorinated biphenyls.

Overall, research funding for the Department of Agriculture is up 3% to $980 million. However, funding for the Cooperative State Research Services shows no increase at $304 million, even though the conferees rejected the Administration's proposal to abolish the special research grants program, funded at $31 million, which is aimed at specific problems such as the blueberry shoestring virus.

For the Department of Interior, research funding for the Bureau of Mines increases 6% to $88 million, and for the Fish & Wildlife Service it rises 12% to $60 million.

In one of the few budget decreases, the Environmental Protection Agency's extramural R&D budget is down 8% to $186 million, with $10 million earmarked for systematic research to reduce uncertainties in risk assessment.

Janice Long, Washington

Study Revises Cancer Risk from Radon

A new National Research Council study of the health effects of radon has moved the estimate for increased risk of lung cancer deaths due to lifetime exposure more to the middle of a range bracketed by earlier studies. It also notes that most of the increased risk of lung cancer from radon exposure is in smokers.

The study, released early this month, was jointly sponsored by the Environmental Protection Agency and the Nuclear Regulatory Commission and resulted from a charge to the National Research Council's Committee on the Biological Effects of Ionizing Radiations (BEIR). In its study, the committee focused on alpha-emitting radionuclides known to induce health effects in exposed human populations. Although the study deals also with other alpha emitters—polonium, radium, thorium, uranium, and transuranic elements—the committee paid particular attention to radon and its decay products because of concern over lung cancer risk associated with increased indoor concentrations of radon in homes.

Risk estimates in the study are calculated for exposures in units of working-level months, a unit originally designed for monitoring radon exposures to underground miners. A working level is defined as any combination of the short-lived radon daughters in 1 L of air that results in the ultimate release of 1.3 $\times 10^5$ MeV of potential alpha energy—about the amount emitted by the short-half-life daughters in equilibrium with 100 picocuries of radon. Exposure of a miner to this concentration for a working month of 170 hours (or equivalent combination) is defined as a WLM.

The committee estimates that lifetime exposure to a radon level of one working-level month (WLM) per year increases the number of deaths due to lung cancer by a factor of about 1.5 over the current rate for both sexes in a population having the current prevalence of cigarette smoking. In smokers, the committee finds, the risk is 10 or more times greater than that for nonsmokers.

Estimates by the committee now put the additional deaths that would occur from lung cancer at 350 for every 1 million people exposed over a lifetime to 1 WLM of radon. A 1984 study by the National Council on Radiation Protection & Measurements—used currently by many U.S. radiation experts to estimate radon lung cancer risks—placed the number at 130. And a 1980 report from the National Research Council called BEIR III estimated the excess deaths for the same exposure at 730.

The results in the current study stem from use of a new model by the committee for estimating an individual's lung cancer risk due to radon and its decay products. Previous models have depended solely on the person's total exposure. The committee employed statistical techniques that also incorporate the effects of age at exposure and time since the exposure occurred.

The committee found that lung cancer risks associated with exposure to radon increase with increasing length of exposure. It says that 15 years after exposure to radon has ended, the risk from that exposure declines to half the original risk.

The new statistical techniques were developed to analyze four major studies of radon and lung cancer. The studies looked at uranium miners in Ontario, Saskatchewan, and the Colorado Plateau, and metal miners in Sweden. But the committee cautions that its risk estimates should not be considered precise because of uncertainties affecting the estimates—from sampling variation in the primary data to misspecification of the components of the models. Most of the study's conclusions are based on studies of miners exposed to radon. The conditions under which radon is inhaled in the home may be significantly different, the committee notes.

In most homes, 4 picocuries of radon per L of air—the more common unit in this case—is equivalent to 0.02 working levels. Hence, someone living in a home with a level of 4 picocuries per L and staying at home an average of 12 hours per day would receive an annual exposure of about 0.5 WLM.

Radon-222 is the isotope of the element that has the most important impact on human health. Radon-219 (actinon), with a half-life of 3.9 seconds, and radon-220 (thoron), with a half-life of 56 seconds, occur naturally and have alpha-emitting decay products. But because of the short half-lives, concentrations are usually low. Radon-222 is a naturally occurring decay product of radium-226, the fifth daughter of uranium-238. These are present in most soils and rocks in widely varied concentrations, and thus radon gas is ubiquitous. It decays with a half-life of 3.82 days into a series of daughters. Two of the daughters—polonium-218 and polonium-214—emit alpha particles. If emission occurs in the lung, it can ultimately lead to lung cancer.

The report, "Health Risks of Radon and Other Internally Deposited Alpha-Emitters: BEIR IV," is available for $32.50 (paperbound) or $42.50 (clothbound) from National Academy Press, 2101 Constitution Ave., N.W., Washington D.C. 20418.

James Krieger, Washington

New study finds midlevel risk of lung cancer

Study[a]	Excess lifetime lung-cancer mortality (deaths per million person WLM[b])
Current BEIR IV (1987)	350
National Council on Radiation Protection & Measurements (1984)	130
National Research Council BEIR III (1980)	730
United Nations Scientific Committee on the Effects of Atomic Radiation (1977)	200–450

a Comparisons of estimates of lifetime risk of lung-cancer mortality due to a lifetime exposure to radon progeny. b Working-level month.